



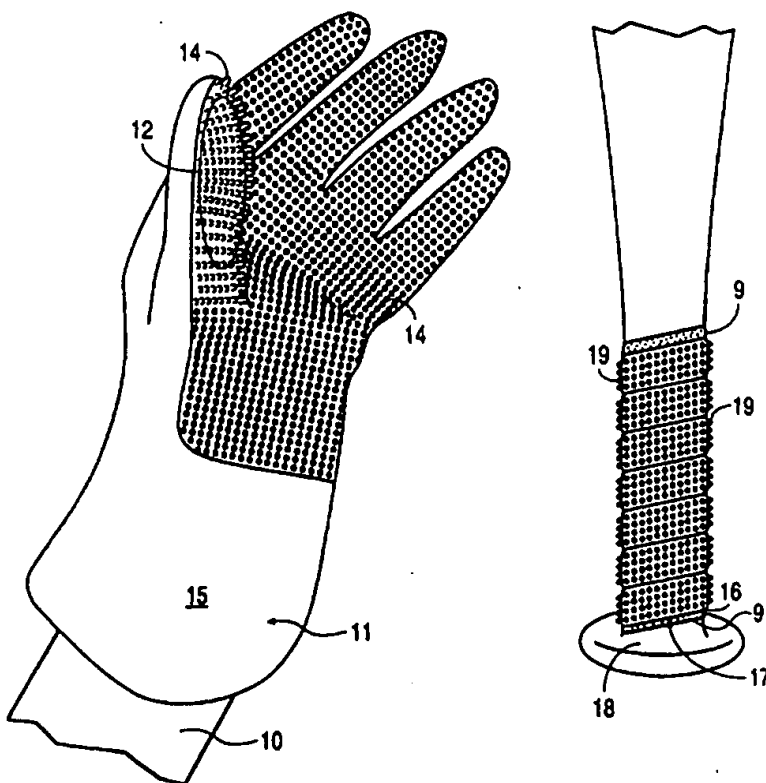
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(21) International Application Number: PCT/US97/00545 (22) International Filing Date: 30 January 1997 (30.01.97) (30) Priority Data: 593,957 30 January 1996 (30.01.96) US (71)(72) Applicant and Inventor: BROFFMAN, Jeffery, A. [US/US]; Suite B-3, 7064 Corline Court, Sebastopol, CA 95472 (US). (74) Agents: MacDONALD, Thomas, S. et al.; Skjerven, Morrill, MacPherson, Franklin & Friel, Suite 700, 25 Metro Drive, San Jose, CA 95110 (US).	(81) Designated States: AU, CA, JP, MX, NZ, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>With amended claims.</i>	

(54) Title: **FRICTIONAL INTERFACE BETWEEN BODIES**

(57) Abstract

A frictional interface is provided between a first body such as a person's hand (10) or foot and a second body such as a sporting goods or tool handle (18) or a floor (23) or structural device e.g. railing surface (30). A first material (11) is attached to the first body, and has a series of protrusions (14) in a fixed spaced array. A second material (16) is attached to the second body (18), and has a similar series of protrusions (19). The respective series of protrusions have non-adhesive surfaces and interdigitate with each other when the bodies are brought into abutting parallelism with each other by an applied force such as a gloved hand grasping or a shod foot stepping on the second material. Lateral displacement of the interdigitated protrusions is substantially prevented, without substantially affecting generally parallel disengagement of the respective series of protrusions when the applied force is removed.



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FRICTIONAL INTERFACE BETWEEN BODIES

BACKGROUND OF THE INVENTIONField of the Invention

5 The present invention relates to an interface
between two bodies, more particularly it relates to
sporting goods handles or grips, tool handles,
construction devices, railings or deck or floor
surfaces which are to be grasped and held by a human
10 user's hand or foot. Additionally, the invention
relates to materials attached to a hand, glove or foot
which interact with a similar material on another body.

Material Art

15 Heretofore others have suggested ways to improve
the human grip on an article which is grasped or
contacted by the human hand or foot. These articles
have included various sporting goods such as tennis or
other racquets, footballs, golf clubs, gym equipment,
20 as well as shoes to prevent slipping on a surface.
These are exemplified by U.S. 5,234,740 where a
sheeting with pyramid-shaped protrusions is attached to
sporting equipment handles or surfaces or on tools.
U.S. 4,946,527 shows a pressure-sensitive adhesive
25 fastener including bulbous projections for closing
parts of a diaper or sanitary napkin. U.S. Patents
3,368,811; 5,028,050; 5,335,916; and 5,451,046
illustrate the use of Velcro® fasteners interlocking a

golf club and golf glove and interlocking a ball and a catching glove. U.K. Patent 547946 shows the use of emery cloth or other abrasive frictional material on either a golf club or a golf glove.

5 All of the above patents describe interfaces which either have only one of the articles or hand with the projections or provide both a lateral lock and a lock in the direction of the removal of the applied force i.e. generally perpendicular to the lateral directions
10 of the lateral lock. For example, in the use of the various Velcro® fasteners the gloves in the penultimate listed four patents must be sheared from the article and are not free to be generally disengaged easily from any direction from the article when the gripping force
15 is released.

SUMMARY OF THE INVENTION

The present invention and product ("the product") creates improved traction for a variety of human
20 physical applications but at the same time permits easy disengagement. The traction is meant to be improved particularly in the plane perpendicular to the main force applied. As an example, if a person is gripping a tubular object, this product will significantly
25 prevent movement from side to side as well as in an inferior or superior direction if the tubular object were to be held horizontally. When the main force

applied is released, then disengagement easily occurs. In addition, as a safety feature, if too great of a force is applied from a direction perpendicular to the main force, then the traction will be overcome and the "grip" created by the product will be released. This product is designed to be effective both for dry (land) and wet (aquatic) activities.

The invention consists of two identical or matching/integrated irregular surfaces not necessarily made of the same material. One or both may be made either of rubber, plastic or other stiff yet pliable material while the other may be made of a nonflexible substance such as metal, rigid plastic or fiberglass. When these two surfaces are placed together they will interlock or interdigitate. The interdigitation achieved is sufficient to create traction as described above, but releases easily. These surfaces are designed for multiple applications and therefore will be of varying sizes, thicknesses, stiffness, material and design depending on the particular use. One or both of the surfaces may have a self-sticking compound (i.e., tape) or may be attached by any adhesive product (i.e., glue) so that it can be applied to various already existing structures or devices.

In one product application a material with protrusions in a fixed spaced array is attached to the volar (gripping) surface of gloves and a material with

matching protrusions in a fixed spaced array is attached to the gripping area of a baseball bat, tennis or other racquet, golf club, hockey stick, or the like. This matching configuration of surfaces will achieve

5 desired improved traction and grip as recited above. In another product application the material with protrusions is formed or molded into the volar surface of surgical gloves as described above which interdigitates with the identical or matching

10 configuration and sized protrusions which are generally made of a different material, such as the metal handle on surgical instruments. The material may be placed on the handle of hand tools, or on the plastic handle of a screwdriver. Further one material may be attached to

15 gloves and a matching material from a tape roll of material secured to such objects as construction devices such as a ladder, a railing along a stairway, a doorknob, or the like, for use of those needing a secure initial grip on the object with a quick parallel

20 to the gripping force release. In still another product application a material with the protrusions is attached to the bottom of footwear either by a tape or glue or is an integral molded component and then an identical or matching surface of same or different

25 material is mounted on or provided as an integral component of a surface to be walked on. This includes the placement of one material on the bottom of "deck

shoes" and the matching material applied (or as an integral component of) to the deck of a sailboat or other vessel. Still another application would be the material being applied to the bottom of boots and the
5 matching material applied on the floor of a fish, meat or poultry processing plant to prevent employee slips.

An additional sporting goods application is the attachment of a first material with protrusions to the top or front portion of wetsuit booties (or built
10 integral with the bootie). The complimentary material (either attached or as an integral unit) is attached to a corresponding undersurface of a footstrap on a sailboard, water ski or the like. This configuration will create traction and grip when the main force (from
15 the foot) is applied upward and be released when the upward force is discontinued. Still further the first material may include roughened protrusions attached to the bottom of shoes and similar roughened protrusions extending from the second material attached to a
20 skateboard. This enables a skateboard user to "jump" the skateboard into the air without losing contact due to the effect of gravity on the skateboard. Therefore, in this application, there would be traction in a direction perpendicular to the main force as well as
25 some traction, though to a lesser degree, parallel to it. The traction parallel to the main force would be designed so that with only minimal effort from the user

it could be released.

A frictional interface between a first body and a second body is described herein where an interface includes a first material attached to a first body, the first material having a first series of protrusions in a fixed spaced array, the series of the first protrusions extending from a surface of the first material. A second material is attached to the second body, the second material also having a second series of protrusions in a fixed spaced array extending generally perpendicularly from a surface of the second material. The first and second series of protrusions have non-adhesive surfaces and interdigitate with each other when the first body and second body are brought into abutting parallelism with each other by an applied force, such that lateral displacement of the interdigitated protrusions is substantially prevented, without substantially affecting generally parallel (to the protrusions) disengagement of the first series of protrusions and the second series of protrusions when the applied force is removed.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of the invention showing the impending interdigitation of protrusions in both a glove material on a hand and on a sporting goods handle.

Fig. 2 is a schematic side view of a series of steps with a railing with the railing having a material including a series of protrusions for grasping by the gloved hand of Fig. 1.

5 Fig. 3 is a schematic side view of the invention showing the impending interdigitation of protrusions on a person's shoe sole and protrusions extending upwardly from a floor surface.

Fig. 4 is a perspective view of a second
10 embodiment of a protrusions-containing glove.

Figs. 5-10 are perspective views of typical shapes and surfaces of the protrusions.

Fig. 11 is a perspective view of one of the materials of Fig. 1 showing the spacing of the
15 protrusions on a portion of a material.

Fig. 12 is a perspective view of interdigitated portions of both materials.

Fig. 13 is a perspective view of the invention showing the impending interdigitation of protrusions on
20 a water sports foot bootie and protrusions on the underside of a footstrap on a sailboard or the like.

Fig. 14 is an end view of a material tape roll containing the protrusions, with self-stick adhesive and peel-off paper backing.

25

DETAILED DESCRIPTION

Figs. 1 and 4 shows a first body in the form of a

human hand 10 on which is placed a first material 11 formed and sized in the form of a glove to be worn and removably attached to the hand. The glove may have full or partial fingers (Fig. 4). The material 11 may
5 be a leather, rubber, fabric, e.g. nylon or cotton or plastic glove which contains a series of molded-in-place or stitched or adhesively attached pad-inserts 12 (Fig. 4), particularly on a volar (palm) surface of the glove, each of which contain a series of columnar
10 protrusions 14, generally extending perpendicularly from regions on the surface 15 of the glove. A second material 16 with matching protrusions 19 on the outside surface, in the form of a tape 17 or sheet, is attached preferably by an adhesive on the reverse side of the
15 material, to a handle 18 of a sporting device such as a baseball bat, hockey or lacrosse stick or tennis, badminton, squash, or other racquet or a weightlifting bar. The handle 18 may also be a tool handle such as a hammer handle, ax handle or a handle for a surgical
20 tool. A padding 9 such as synthetic foam tape or sheet e.g. EVA may be applied and bonded by adhesive under the material 16. In a horizontal orientation of the bat or tool relative movement side to side and in the inferior and superior directions is prevented by the
25 grasping applied force on the materials and protrusions. As seen in Fig. 4 illustrated by glove cut-off lines 15a and 15b the glove may be a half-

glove. Also the volar portion may be a protrusions-
containing adhesive tape which is wound around the hand
across the palm and back of the hand. This is
especially useful when using a weight lifting bar also
5 having protrusions-containing tape wound on spaced
portions of the bar.

Fig. 2 shows a further application, where one or
two gloves 15 of the type seen in Figs. 1 or 4 are used
in conjunction with a railing 30 associated with a set
10 of stairs 31 raising from a floor surface 32. The
railing 30 has vertical supports 33 and is covered or
partially covered by a tape or sheet material 34 having
a series of projections 35 extending therefrom. As a
gloved user walks up or down the stairs the user's hand
15 grasps the railing 30 and the respective protrusions on
the glove and on the material affixed to the railing
interdigitate, preventing slippage of the hand on the
railing while permitting easy disengagement of the
gloved hand from the railing as each step up or down
20 the stairs is taken. This can be especially useful for
infirm persons walking up or down stairs or a railed
ramp. The second material may also be applied to the
railings or steps of a ladder.

Fig. 3 illustrates an application of the product
25 to a walking or boating shoe 20 where the material 21
with a first series of protrusions 22 is applied to the
sole of the shoe. Complementary to the shoe is a floor

surface 23 or boat deck or skateboard on which a second material 24 having a second series of protrusions 25 is affixed. As a pedestrian or boater places his or her so-equipped shoes down on the second material in a forward stepping motion (arrow 26), with an applied force represented by the weight of the person, the first and second series of protrusions interdigitate with each other, as best shown in Fig. 12, to prevent forward and side sliding of the shoe with respect to the floor surface 23 and the fixed attached material 24. In the same stepping time frame, as the step is being completed, the first series of projections are not impeded from releasing or disengaging in a generally parallel direction from between the second series of projections, as the applied force of the step is removed. In one embodiment at least one of the materials may be a relatively stiff but pliable rubber or plastic such as polyurethane or a flexible epoxy. The material attached to the floor surface may be an inflexible material or plastic such as an epoxy or polyethylene with raised integral protrusions as in a skateboard application as seen in Fig. 3.

Figs. 5-10 illustrate that the series of protrusions on both the first material and the second material may be smooth cylinders 40 (Fig. 5), smooth cubic structures 41 (Fig. 6), smooth octagonal cylinders 42 (Fig. 7), a roughened cylinder 43 with

projecting cylindrical nubs 44 (Fig. 8), annular projections 46 on a curved top cylinder 45 (Fig. 9), or a cubic structure 47 with annular trapezoidal projections 48 (Fig. 10). [The protrusions may be rod-like with a height of from about 1 mm to about 2 cm with a diameter of about 1 mm to about 2 cm.] Other smooth or roughened surface areas on the protrusions may be provided, the roughened surfaces providing a predetermined small amount of friction during disengagement of the sets of protrusions as in a skateboard application as seen in Fig. 3.

Fig. 11 illustrates in blow-up that the diametrical space 28 between each of the series of protrusions 14 (Fig. 1) or series of protrusions 19 (Fig. 1) has a diameter A which is larger than the diameter B (or maximum cross-sectional dimension) of the protrusions so that the protrusions of one series will interdigitate and then easily disengage when an applied force is released.

Fig. 12 illustrates the actual engagement of one protrusion 19 from one material between four protrusions 14 of another material in a checkerboard grid. The gaps 29 between the interdigitated protrusion are shown as relatively wide for clearer viewing purposes. Gaps of from about 2 mm to about 2 cm may typically be employed. The respective series of protrusions may be of different diameters with the

spacing adjusted to form an appropriate small gap between the interdigitating protrusions.

Fig. 13 shows another sporting goods application where a foot bootie 60 is worn by a water sportsperson.

5 A first material 61 (rubber or plastic) in the form of an insert molded into or adhesively attached and/or sewn to the instep 63 of the bootie, contains a series of protrusions 62. A second material 66 is attached to or molded in a footstrap 65 which is mounted to a

10 sailboard or the like. The second material extends from the bottom surface of a central bow 67 of the strap and contains a matching series of protrusions 68. A user places his bootied foot in the strap 65, and moves his or her foot upward to interdigitate the

15 upwardly extending protrusions 62 on the booties instep with the downwardly depending protrusions 68 on the material 66.

Fig. 14 shows a roll of flexible tape 16 including protrusions 19 on one side, with a peel-off backing

20 paper 80 on the other side which can be removed to expose a layer of self-stick adhesive 81 which will affix the tape to a handle, bar or other body or hand as shown in Fig. 1.

The above description of embodiments of this

25 invention is intended to be illustrative and not limiting. Other embodiments of this invention will be obvious to those skilled in the art in view of the

above disclosure.

CLAIMS

1. A frictional interface between a first body and a second body, said interface comprising:

a first material attached to said first body,
5 said first material having a first series of protrusions in a fixed spaced array, said series of said first protrusions extending from a surface of said first material;

a second material attached to said second
10 body, said second material having a second series of protrusions in a fixed spaced array, said second series of protrusions extending generally from a surface of said second material; and

wherein said first and second series of
15 protrusions have non-adhesive surfaces and interdigitate with each other when said first body and second body are brought into abutting parallelism with each other by an applied force, such that lateral displacement of said
20 interdigitated protrusions is substantially prevented, without substantially affecting generally parallel disengagement of said first series of protrusions and said second series of protrusions when the applied force is removed.

25
2. The interface of Claim 1 wherein said first body is a glove and said first material is attached to

the volar surface of the glove and said second body is a sporting goods handle and said second material is attached to a gripping area of said handle.

5 3. The interface of Claim 2 wherein said first and second materials are flexible materials and said first series of protrusions comprise first integral spaced cylinders and said second series of protrusions
10 comprise matching second integral spaced cylinders interfitting with said first integral spaced cylinders.

 4. The interface of Claim 2 wherein said handle is a tubular handle, the glove comprises one or two
15 gloves worn on the hands of a person, and the applied force is a gripping force by the person on said tubular
handle, and wherein upon gripping, relative movement of the glove or gloves and tubular handle side to side and
in inferior and superior directions is prevented.

20 5. The interface of Claim 2 wherein said sporting goods handle is a baseball bat handle.

 6. The interface of Claim 2 wherein said sporting goods handle is a tennis racquet handle.

25

 7. The interface of Claim 2 wherein said sporting goods handle is a golf club shaft.

8. The interface of Claim 2 wherein said sporting goods handle is a hockey stick handle.

9. The interface of Claim 2 wherein said
5 sporting goods handle is a lacrosse stick handle.

10. The interface of Claim 2 wherein said sporting goods handle is a weightlifting bar.

10 11. The interface of Claim 1 wherein said first body is a walking shoe and said first material is attached to the shoe sole; said second body is a floor surface and said second material is attached to the floor surface; and

15 the applied force is the weight of a person wearing the shoe, such that upon a step by person onto the second material, the shoe is prevented from sliding relative to the floor surface and when the step is completed and the applied force
20 released, disengagement of the interdigitated protrusions occurs.

12. The interface of Claim 1 wherein at least one of said first material and said second material is a
25 relatively stiff and pliable rubber or plastic.

13. The interface of Claim 1 wherein one of said

first and second materials is an inflexible material of metal or plastic.

14. The interface of Claim 1 wherein the first
5 body is a human hand or foot and said first material is an adhesive tape attached to the hand or foot; and

said second body is a hand or foot gripping body and said second material is attached to or integral with such hand or foot gripping body.

10

15. The interface of Claim 1 wherein each of the series of protrusions are a series of rods of from about 1 mm to about 2 cm in height, said rods being spaced from each other such that the rods of the first
15 series of protrusions interdigitate with the rods of the second series of protrusions.

16. The interface of Claim 1 wherein said first body is a surgical glove and said first material
20 extends from a volar surface of the glove and said second body is a surgical instrument.

17. The interface of Claim 1 wherein said first body is a glove or tape on a person's hand and said
25 second body is a ladder or a railing.

18. The interface of Claim 1 wherein said first

body is a wetsuit bootie and said second body is a footstrap of a sailboard.

19. The interface of Claim 18 wherein the first
5 material is located on the instep of said bootie and the second material is located on an underside of the footstrap.

20. The interface of Claim 1 wherein the first
10 body is a deck shoe and said first material extends from the soles of the shoe; and said second body is a boat deck.

21. The interface of Claim 1 wherein said first
15 and second series of protrusions extend generally perpendicularly from said first and second materials, respectively.

22. The interface of Claim 1 wherein at least one
20 of said surfaces of said first and second series of protrusions includes a roughened surface to create partial traction in a direction parallel to the applied force.

23. The interface of Claim 22 wherein the first
25 body is a sporting shoe and the second body is a skateboard such that the roughened surface permits a

skateboarder to jump the skateboard into the air without losing contact with the board due to gravitational force.

5 24. The interface of Claim 1 wherein said first and second series of protrusions are of the same size and in a checkerboard grid on the respective first and second materials.

10 25. The interface of Claim 1 wherein said first and second series of protrusions vary in size.

 26. The interface of Claim 1 further comprising a padding on at least one of said first and second
15 materials under at least one of the first and second series of protrusions.

AMENDED CLAIMS

[received by the International Bureau on 27 May 1997 (27.05.97);
original claim 21 cancelled; original claims 1 and 2
amended; remaining claims unchanged (6 pages)]

1. A frictional interface between a first body
and a second body, said interface comprising:

5 a first material attached to said first body,
said first material having a first series of
protrusions in a fixed spaced array, said first
series of said protrusions extending generally
perpendicular from a surface of said first
material;

10 a second material attached to said second
body, said second material having a second series
of protrusions in a fixed spaced array, said second
series of protrusions extending generally
perpendicular from a surface of said second
15 material; and

wherein said first and second series of
protrusions have non-adherent matching surfaces and
interdigitate with each other without interlocking
when said first body and second body are brought
20 into abutting parallelism with each other by a
continuing applied force, with said first series of
protrusions having longitudinal generally smooth
surfaces which are parallel to longitudinal
generally smooth surfaces of said second series of
25 protrusions such that lateral displacement of said
interdigitated protrusions orthogonal to said
surfaces is substantially prevented, without
substantially affecting generally parallel
disengagement of said first series of protrusions

and said second series of protrusions from each other when the applied force is removed.

2. The interface of Claim 1 wherein said first
5 body is a glove and said first material is attached to a volar surface of the glove and said second body is a sporting goods handle and said second material is attached to a gripping area of said handle.

10 3. The interface of Claim 2 wherein said first and second materials are flexible materials and said first series of protrusions comprise first integral spaced cylinders and said second series of protrusions comprise matching second integral spaced cylinders
15 interfitting with said first integral spaced cylinders.

4. The interface of Claim 2 wherein said handle is a tubular handle, the glove comprises one or two gloves worn on the hands of a person, and the applied
20 force is a gripping force by the person on said tubular handle, and wherein upon gripping, relative movement of the glove or gloves and tubular handle side to side and in inferior and superior directions is prevented.

25 5. The interface of Claim 2 wherein said sporting goods handle is a baseball bat handle.

6. The interface of Claim 2 wherein said sporting goods handle is a tennis racquet handle.

30

7. The interface of Claim 2 wherein said sporting goods handle is a golf club shaft.

8. The interface of Claim 2 wherein said sporting
5 goods handle is a hockey stick handle.

9. The interface of Claim 2 wherein said sporting goods handle is a lacrosse stick handle.

10 10. The interface of Claim 2 wherein said sporting goods handle is a weightlifting bar.

11. The interface of Claim 1 wherein said first body is a walking shoe and said first material is
15 attached to the shoe sole; said second body is a floor surface and said second material is attached to the floor surface; and

the applied force is the weight of a person wearing the shoe, such that upon a step by person
20 onto the second material, the shoe is prevented from sliding relative to the floor surface and when the step is completed and the applied force released, disengagement of the interdigitated protrusions occurs.

25

12. The interface of Claim 1 wherein at least one of said first material and said second material is a relatively stiff and pliable rubber or plastic.

13. The interface of Claim 1 wherein one of said first and second materials is an inflexible material of metal or plastic.

5 14. The interface of Claim 1 wherein the first body is a human hand or foot and said first material is an adhesive tape attached to the hand or foot; and
 said second body is a hand or foot gripping
 body and said second material is attached to or
10 integral with such hand or foot gripping body.

15 15. The interface of Claim 1 wherein each of the series of protrusions are a series of rods of from about 1 mm to about 2 cm in height, said rods being spaced
15 from each other such that the rods of the first series of protrusions interdigitate with the rods of the second series of protrusions.

20 16. The interface of Claim 1 wherein said first body is a surgical glove and said first material extends from a volar surface of the glove and said second body is a surgical instrument.

25 17. The interface of Claim 1 wherein said first body is a glove or tape on a person's hand and said second body is a ladder or a railing.

30 18. The interface of Claim 1 wherein said first body is a wetsuit bootie and said second body is a footstrap of a sailboard.

19. The interface of Claim 18 wherein the first material is located on the instep of said bootie and the second material is located on an underside of the
5 footstrap.

20. The interface of Claim 1 wherein the first body is a deck shoe and said first material extends from the soles of the shoe; and said second body is a boat
10 deck.

22. The interface of Claim 1 wherein at least one of said surfaces of said first and second series of protrusions includes a roughened surface to create
15 partial traction in a direction parallel to the applied force.

23. The interface of Claim 22 wherein the first body is a sporting shoe and the second body is a
20 skateboard such that the roughened surface permits a skateboarder to jump the skateboard into the air without losing contact with the board due to gravitational force.

25 24. The interface of Claim 1 wherein said first and second series of protrusions are of the same size and in a checkerboard grid on the respective first and second materials.

25. The interface of Claim 1 wherein said first and second series of protrusions vary in size.

26. The interface of Claim 1 further comprising a
5 padding on at least one of said first and second materials under at least one of the first and second series of protrusions.

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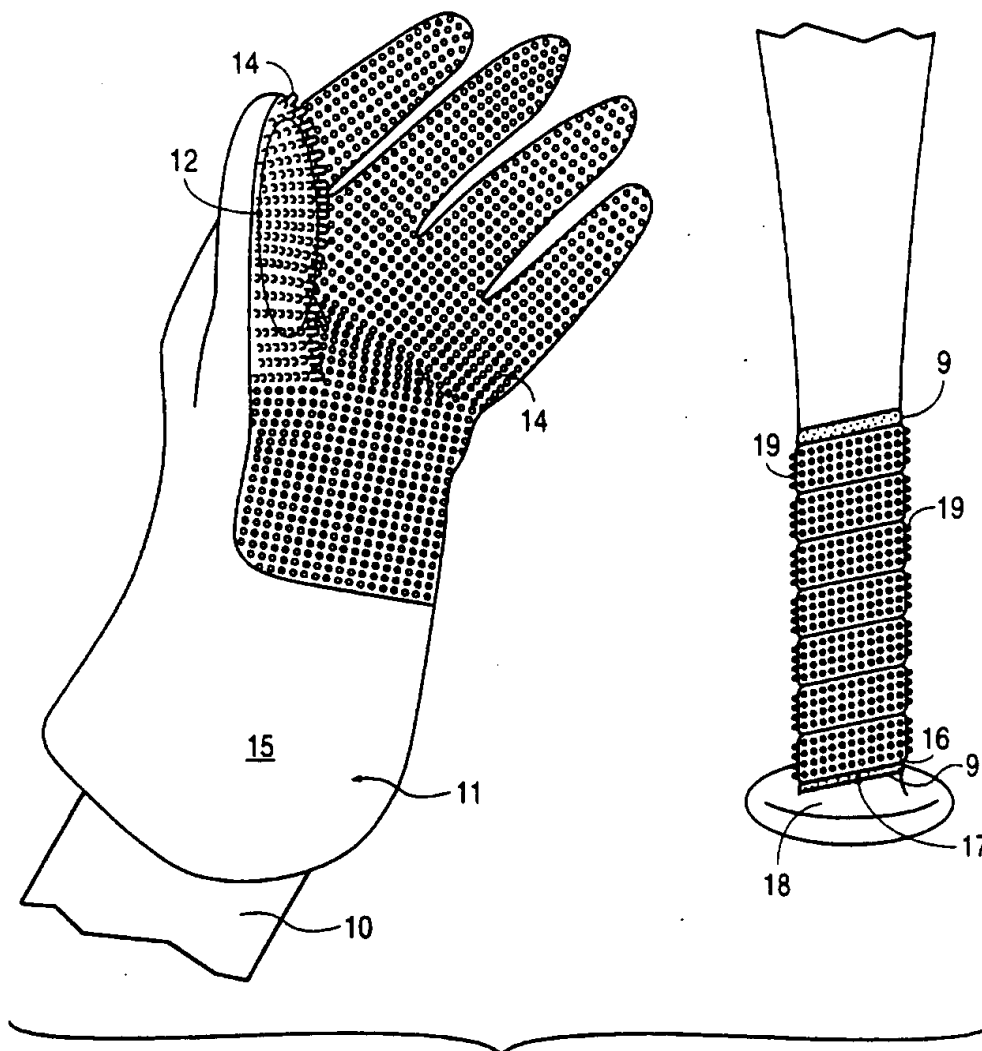


FIG. 1

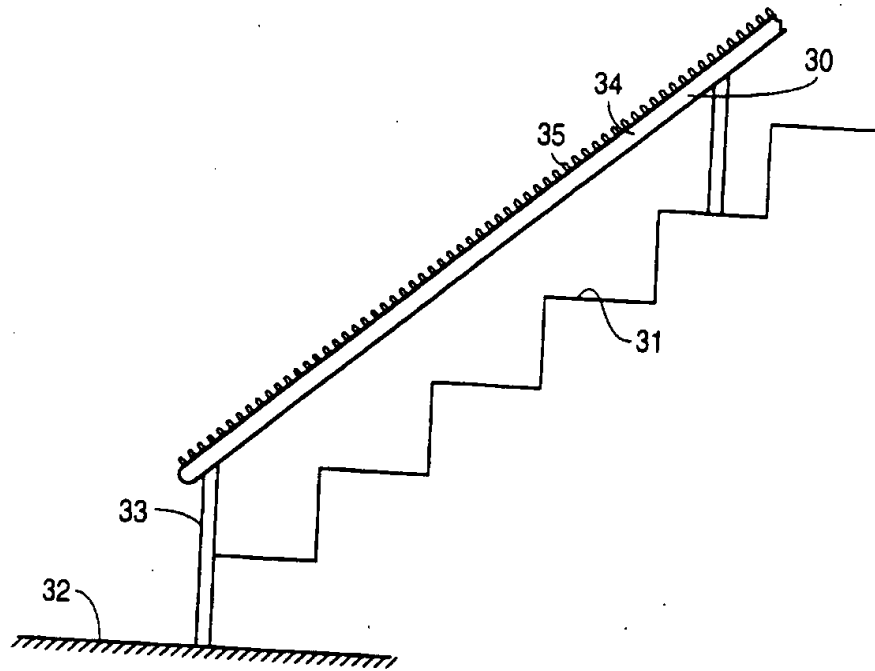


FIG. 2

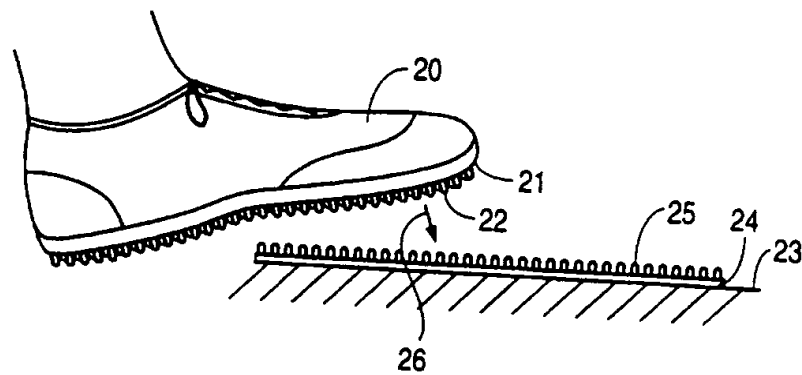


FIG. 3

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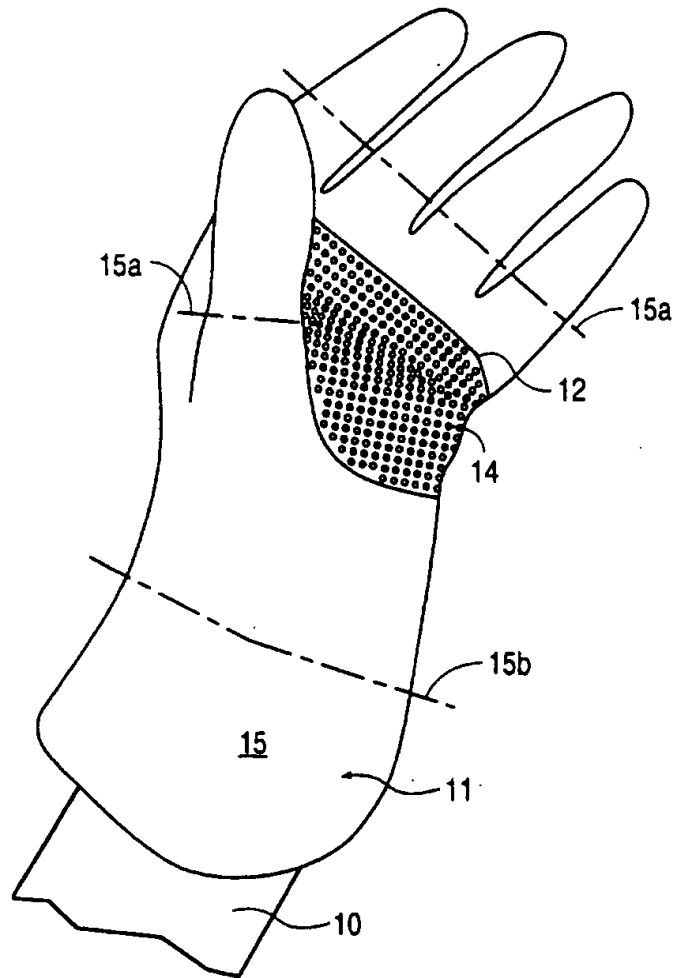


FIG. 4

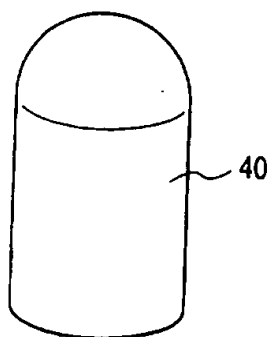


FIG. 5

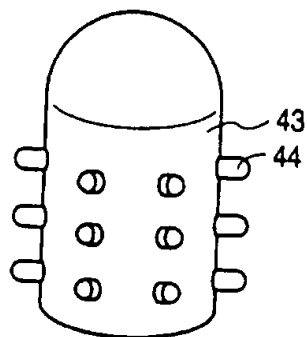


FIG. 8

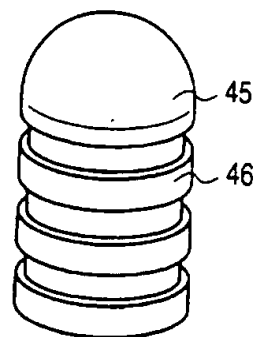


FIG. 9

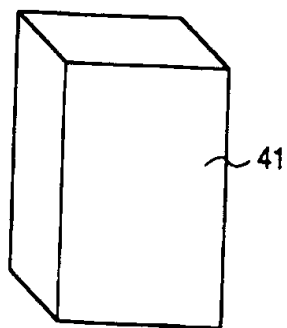


FIG. 6

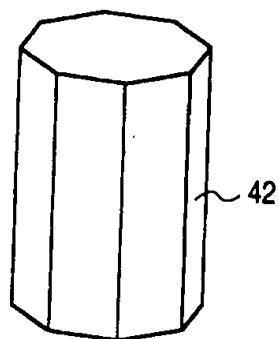


FIG. 7

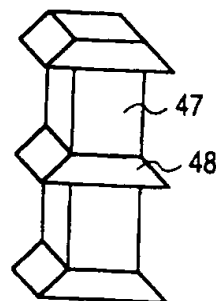


FIG. 10

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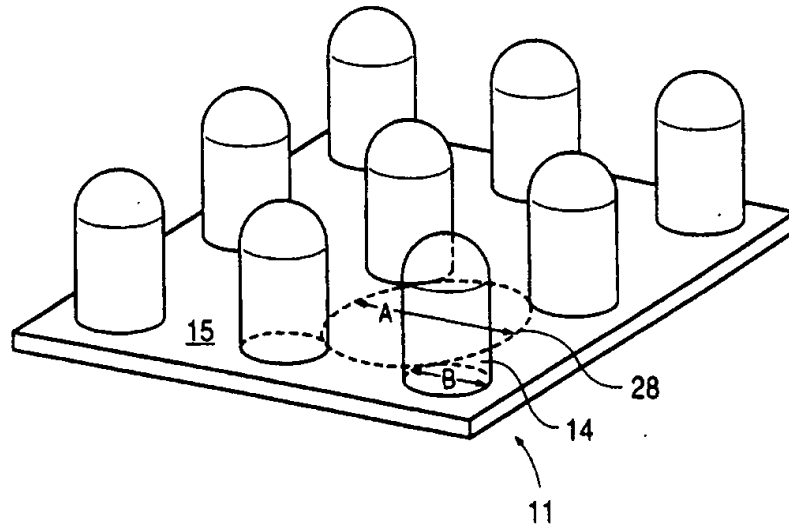


FIG. 11

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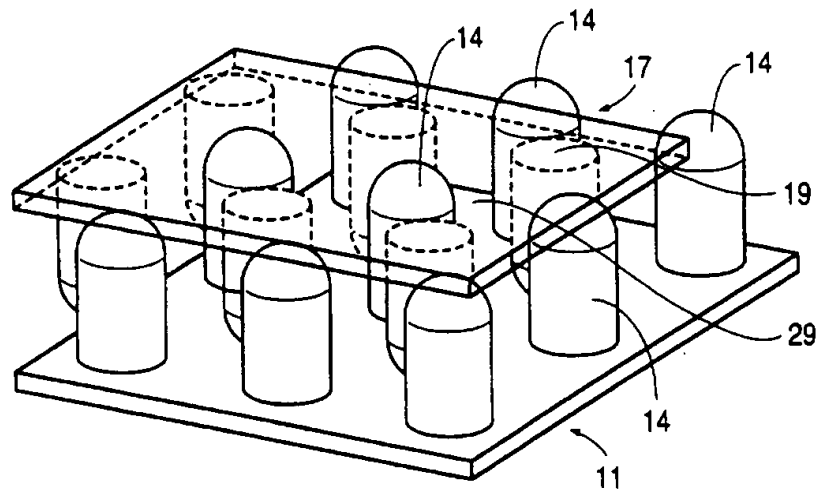


FIG. 12

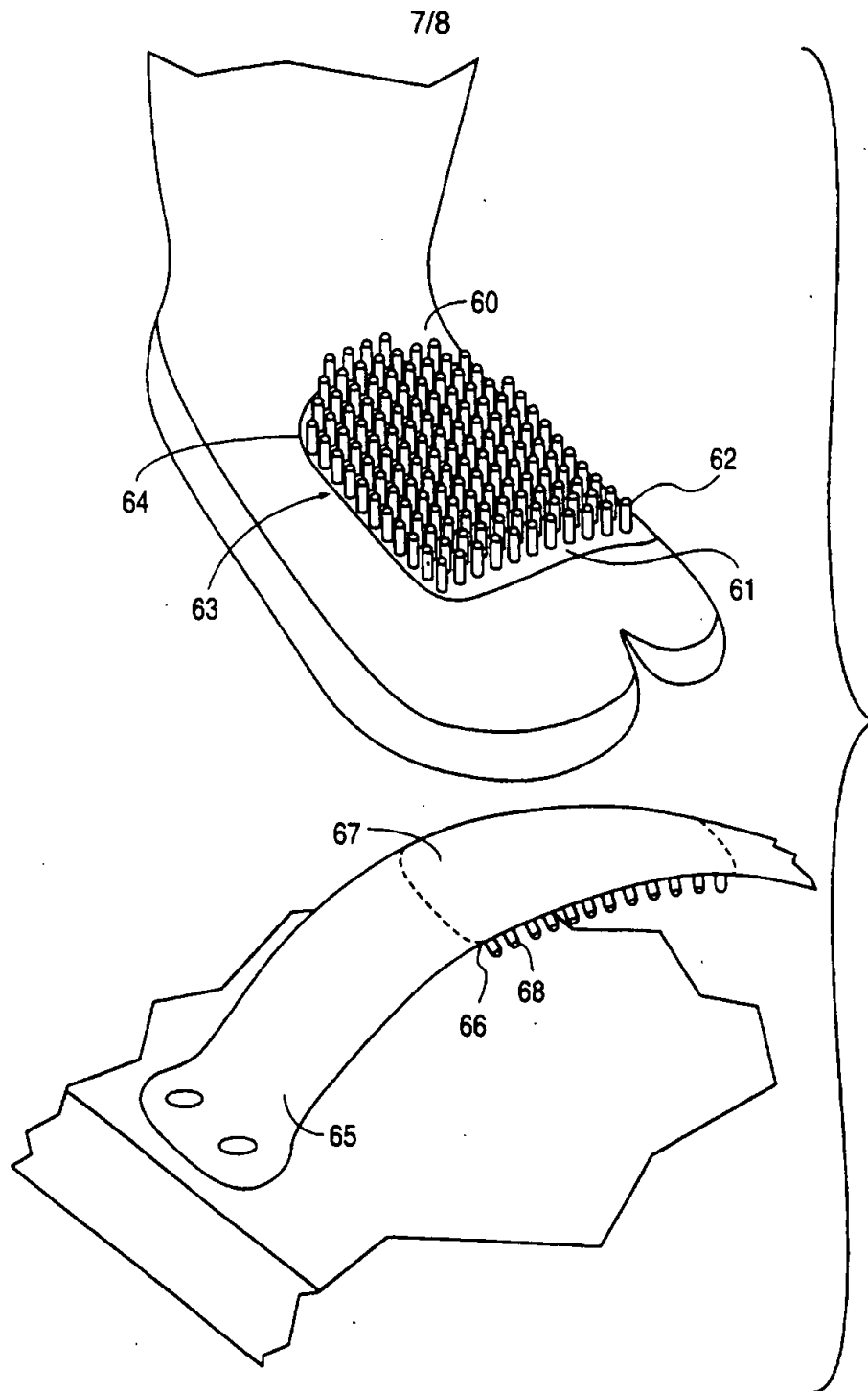


FIG. 13

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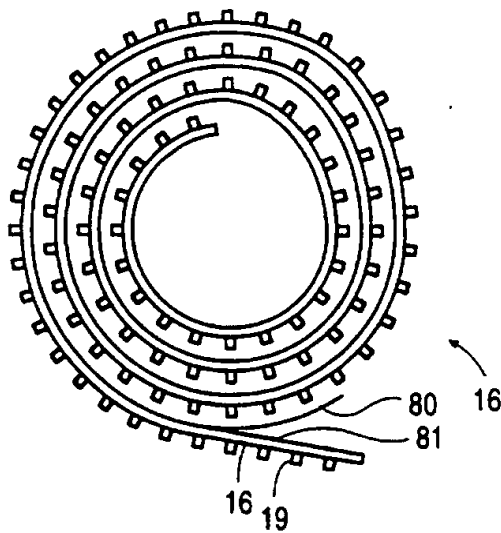


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US97/00545

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A44B 21/00; A63B 59/06

US CL :24/443; 273/205, 549, 568

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 2/161.3; 16/DIG. 12; 24/443; 74/551.9; 483/205, 206, 298-300, 302, 549, 551, 564, 566-568

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 3,368,811 A (FINNEY) 13 February 1968, whole document.	1, 2, 4, 5, 21, 25 ----- 3, 12, 13, 15, 24
Y	US 4,946,527 A (BATTRELL) 07 August 1990, whole document.	12, 15, 24
Y	US 3,471,903 A (NORTHROP et al.) 14 October 1969, whole document.	1-11, 13, 14, 16-23, 25, 26

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principles or theory underlying the invention
*A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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*L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"A" document member of the same patent family
*O" document referring to an oral disclosure, use, exhibition or other means	
*P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 14 MARCH 1997	Date of mailing of the international search report 10 APR 1997
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer MARK S. GRAHAM
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